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ABSTRACT

This paper describes the conditions of physics instruction and curriculum in the former East Germany and compares aspects of the curriculum to that of the former West Germany. Topics discussed include: teachers' opinions of the curriculum; perceived difficulty of the curriculum by the students; the educational system of Germany; students' opinions of physics; physics programs for gifted students; teaching conditions; and teacher preparation. Three problems in physics education are cited: (1) the need for curriculum development; (2) the lack of impact of physics research on physics instruction; and (3) the lack of trained physics teachers. (MDH)

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PHYSICS EDUCATION IN EAST AND WEST GERMANY

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PHYSICS EDUCATION IN EAST AND WEST GERMANY

The public school of the former GDR (East Germany) started after 3 years of kindergarden with age 6 or 7. Grade 1 to 4 were "Unterstufe", elementary school. Grade 5 to 10 were secondary school. All grades were usually in the same building and each student was in the same class from grade 1 until grade 10. Everyone had to take the same courses, there was a timetable for each class. After 10th grade you could go to a school for vocational training to learn a profession or you could continue your school in grade 11 or grade 12. This was called extended secondary school. After grade 12 you could start your study at a university.
Physics started in grade 6 - everyone had to take it until he/she finished school (grade 10 or 12). Who were the physis teachers? You became a teacher for physics after 12 years of school and a 5 year study at a university or an educational institute (special universitites for future teachers). You became a mathematics/physics or physics/mathematics teacher, or physics/ chemistry. In any case you were a teacher for two subjects, you have finished your study with the "diplom" and you were allowed to teach grade 5 to 10, after some years of experience also grade 11 and 12. There was almost always a lack of physics teachers (teacher generally), because the teacher job was not good paid. There were more men than women physics teachers, but not as less women as in the U.S.A.! Another very important fact, we had a curriculum for physics (as well as for each other subject) which was the same for the whole country! The curriculum was very well planned and structured and there was almost no room for individual work, almost every lesson was planned with a special topic. So it was in theory - of course each teacher has had room for individual work in some way. We had one textbook for each grade, the same for the entire country. During the past years we had a growing number of hands on activities. The equipment differed from school to school but in any case it allowed an experimental physics class. Let's now have a look at the curriculum:

grade 6	3 lessons per week	mechanics, thermodynamics, optic
grade 7	2 lessons per week	mechanics
grade 8	2 lessons per week	thermodynamics, electricism
grade 9	2 lessons per week	electricism, mechanics, 10 hours lab-work
grade 10	2 lessons per week	mechanics, electricism, optics, nuclear physics, 18 hours lab-work

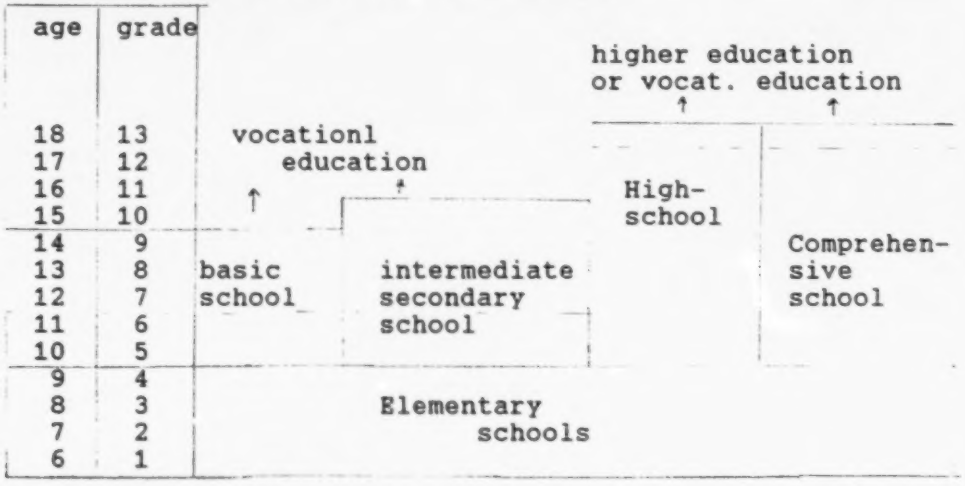
At the end of 10th grade, each student had to take a written examination in chemistry, biology or physics, as well as in German and mathematics. Usually 50% of the students choosed biology, the other 50 % took physics or chemistry. The examination was the same for each students in the entire GDR. The teachers didn't know the tasks, they had to open the envelope with the tasks at the beginning of the examination in front of their students.

What were the opinions of the teachers to the curriculum?
- it is too full-filled
- it is too hard for a large number of students
- it is too much mathematics sometimes and for some students
- it is too less room for actual problems and for discussions

And what did the students say to physics?
Physics is one of the least liked subjects! It is too difficult, too hard, sometimes uninteresting, sometimes it seemed too unimportant to them. Only a few students liked physics.

How is it today? Our educational system (table 1) is now the same as in West Germany. We do have different types of public schools and we do start with physics in grade 7. The number of physics lessons decreased.

TABLE 1 Educational system of Germany



kindergarden (optional) age 3-6

Our former East Germany (GDR) is now devided in 5 big parts, districts, called "Länder". Each Land has made its own curriculum. Each curriculum aagain can differ from school to school, the curricula are not so fixed and full planned They give more freedom for decisions for the teachers, more room for individual work, the level varies within the different school types. Still every student has to take physics, but at most schools he can choose between basic and advanced courses. There exist a large number of textbooks.
What do the teachers say?
-The level isn't as high as it was before.
-The textbooks are much better and make the work much more interesting.
-The textbooks don't fit together with the curriculum.
-There is more room for discussions, this is good!
-The dividing in basic and advanced physics classes is great!
-It is sometimes hard to get used to the new freedom in my work.
In summary: It is more interesting and even often easier.

What do the students say?
This is hard to answer, they can't really evaluate it, they don't feel such a big difference. Unfortunately, they still don't like physics and the teachers are not satisfied with the work of their students. The students are not anymore in their classes, they have also changed schools and teachers. So it is very hard to compare just the subject physics. It s new and also hard for them to

just the subject physics. It s new and also hard for them to discusss about problems. In East Germany it was usually not very good to say your own opinion, to talk about polution or so. Now you shall talk about all the problems, you are allowed to have your own opinion and you shall discuss about problems. This is a very new situation for students - as well as for the teachers.
What has been done for gifted students in science?
During the 80's the discussion on that topic started, although East Germany's educational system had the guideline: Same chances to everyone. We didn't use intellligence tests. The only differenciation could occur during normal lessons and was depending on the teacher. So the most gifted students never got a special education. There were 14 special schools for mathematics and science education in the entire country.(That was much too less.) The students could attend them with grade 9 and got there the mormal education plus more in depth education in science, mathematics and engineering. Before attending such a school they had to pass an examination. Not everyone could visit such a school: the student and his/her parents had to be in favour with the socialistic system of East Germany and very often they had to study what the government wanted them to study. Besides this, the education at those schools has been fairly good and their students were very often the winners at olympiads and international contests. Many of these schools still exist and we think that they could be a good type of school even in the unified Germany.
How can you become a teacher today? You have, after 12 years of school, to study physics or another subject. Then you have to take classes in education generally, in education of your subject, for example physics education, and in psychology, to get your teachers degree. Furthermore, each student has to do two practical trainings at school during the study. In former East Germany each physics teacher student had to take physics methods classes, in West Germany not in any case. Those classes were taught by professors at university, the professors were professors in Physics education. Usually they had a higher degree in physics or were a physics teacher and got then a degree in physics education. I think that it is different to the U.S.A.. Professors in science education in the U.S.A. have mostly a higher degree in psychology or pedagogic than in science. Therefore physics educators in Germany don't have such a strong background in those disciplines. This fact also influences research in physics education. In Germany there is not as much empirical research in physics education as in the U.S.A. At my former university in Guestrow, East Germany, there were more than 10 lectures and professors in physics education for about 300 physics teacher students per year. Only half of the students took physics methods classes at the same time, only during the last 4 semesters of their study. The department of physics education was a part of the physics department. Their tasks were the teaching of physics methods classes, the organization and observing of student teaching and doing their own research. The number of 10 was much too high compared with West Germany. The physics education departments in West Germany belong very often to the education departments. Teachers in West Germany are in a fairly food psition. They are employed by the state and they have a lifelong position. They are well paid, that doesn't mean that a good physicist couldn't make more money in the industry. Teachers in the former East Germany don't get much money now but it will come. First, when the first changes came to the teachers in East Germany, they were

pessimistic and thought that the level was getting too low. One reason was also, that there are now very less physics lessons per week. But now they found a lot of good things in all the changes and they really get optimistic about the new education in physics. Unfortunately, the students still don't like physics and they don't work hard, So we will come to the same situation as it is in West Germany. They have discussed the problems in physics education already for many years. Many researchers thought that in applying the constructivistic view the results could become better, they tried to make the study for future physics teachers more effectively, they did a lot of research in the area of misconceptions - but there are still no better results. We find 3 main problems in physics education:

1. The content of the physics curricula is to renew.
2. The research in didactics didn't reach nor influence the instruction process in physics.
3. There is a lack of trained physics teachers and this situation will become even worse.

On the other hand, West Germany has had good and succesful results in technics, research, science, in industry and economics. The problem will be in future: If the physics education in school is filled with unsolved problems, then the students won't get more interested in physics and who will become physics teachers and pysicists for tomorrow? In East Germany this problem was even worse, because we didn't have such a strong economy and such good results in science and research. Furthermore, we didn't have enough physicists, we had more engineers! Anyway, East Germany attended International physics olympiads as well as West Germany and their results were about the same, West Germany was only a bit better.

My personal opinion, as someone who has lived in East Germany for more than 25 years and who is now a Ph.D. student in West Germany, is the following:
Not only the political changes were very good for East Germany, there is also a better situation now for education, for educators and for students. The teachers will feel more comfortable with the new situation once they got used to work with this new freedom. It is good that we have now different types of schools and different courses in one subject at one school. It is good that you can better reach your students because you can talk and discuss with them everyday problems. The personality of a teacher plays now an even more important role, the "you must" of the old curricula is now a "you may" - and this is a difference. After solving the problems with all the changes at school the East German teachers will help to solve the problems in physics education in the entire unified Germany.

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